READER, PUNCH, AND PRINTER INPUT/OUTPUT ROUTINES

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This document is provisional in nature and is intended as a vehicle for meeting immediate needs with regard to system familiarization and orientation. UNIVAC® Division of Sperry Rand Corporation reserves the right to change and/or modify such information contained herein as may be required by subsequent system developments.

2.0 GENERAL DESCRIPTION

The reader, punch, and printer routines for the tape system are essentially the same as those for the card system. Worker program communication is exactly as stated for the card system. The difference between the card and tape systems lies in the communication that takes place between these routines and the Executive Routine.

Error recovery is effected by the operator through the Executive operator request. (See Section 9 of the Executive Routine UP 3940.12.)

The following specifications, included in the worker program, are used by the I/O library for assembly. The label field is left blank. RDR is written in the operation field for the reader routine, PCH for the punch and PRNT for the printer. The operands field contains a series of parameters separated by commas. The number, nature and interpretation of these expressions is determined by the particular routine being specified, as follows:

In a two printer system the call PRNT7 is available for a channel 7 print routine. The parameters are identical to those for the first printer routine.

Parameter \ Routine	RDR, RDR9, RDS, RDS9, *REA, *REA9, *RES, *RES9	PCH, PCH9, PCHS9, *PUN, *PUN9, *PUNS9	PRNT, PRNT7, PRPL, PRPL7, *PRT, *PRPL
p1	LABEL NAME OF AREA ASSOCIATED WITH ROUTINE		
p2	NUMBER OF RESERVE AREAS 3 to 21	3 to 21	2 to 21
p3	INDEX REGISTER TO CONTAIN RELATIVE AREA ADDRESS		
p4	TRNSL (blank) or UNTRN	TRNSL (blank) or UNTRN	Blank for 128 char., HALF, or 132 (buffered only)

Table 1. TAPE SYSTEM READER, PUNCH, AND PRINTER ROUTINE PARAMETERS

Example: A reader routine is desired to read cards with the translated card images read into one of three reserve areas. The label of the first character of the area is CRDIN. The area relative address of the current card image area is to be supplied in index register 5. The worker program will contain the following line of coding.

LABEL	OP'N	OPERANDS
(blank)	RDR	CRDIN, 3, 5

The object program will contain the proper coding for the reader routine requested.

I/O CALL LINE TAPE SYSTEM ROUTINES	COL	ROUTINE	TOTAL SIZE INCLUDING MIN. NO. OF AREAS	MINIMUM NO. OF AREAS
RDR	80	Row Reader Routine - 80	989	3
RDR9	90	Row Reader Routine - 90	989	3
RDS	80	Column Reader Routine - 80	637	2
RDS9	90	Column Reader Routine - 90	672	2
PCH	80	Row Punch Routine - 80	928	3
PCH9	90	Row Punch Routine - 90	928	3
PCHS9	90	Row Punch (Column) Routine - 90	968	3
PRNT	---	Channel 0 PRINT	908	2
PRNT7	---	Channel 7 PRINT	908	2
PRPL	---	Channel 0 with Paper Low ability	983	2
PRPL7	---	Channel 7 with Paper Low ability	983	2
CARD SYSTEM ROUTINES				
*REA	80	Row Reader - 80	794	3
*REA9	90	Row Reader - 90	794	3
*RES	80	Column Reader - 80	546	2
*RES9	90	Column Reader - 90	576	2
*PUN	80	Row Punch - 80	748	3
*PUN9	90	Row Punch - 90	748	3
*PUNS9	90	Row Punch (Column) - 90	788	3
*PRT	---	Channel 0 PRINT	763	2
*PRPL	---	Channel 0 with Paper Low ability	823	2

Table 2. TAPE SYSTEM READER, PUNCH, AND PRINTER ROUTINE CALLS

3.0 ROW READER ROUTINE

3.1 SUBROUTINES REFERENCED BY WORKER PROGRAM

3.1.1 Initialize (XINRD)

XINRD must be entered before there is any attempt to get a card image. Base address tetrad (tetrad 36), standby address tetrad (tetrad 37) and the channel interrupt entry are set to their appropriate values. All the indicators, counters and variable connectors are reset to their initial conditions. No feed card order is issued. Reinitialization takes place automatically on error recovery.

3.1.2 Execute (XCTRD)

XCTRD must be entered when the worker program wants a new card image. The present reserve area is assumed to be released by the worker program. Thus RAC is increased by 1. A feed card instruction will be issued if there is no card in the track. The base address of the next reserve area available to the worker program is given in the index register specified by p3. If an error condition exists and there is neither a card image ready for processing nor an actual card in the track, the computer will be brought to an orderly stop with the following in the instruction register:

30 11000X 60

where X is 1 or 2 - the number of cards to be reloaded. When no images are available to the worker program, this routine will set the 8 and 4 bits of the unit status list and transfer control to the Executive. Control will be returned to the worker program (when an image becomes available) at XB22, the link entry of XCTRD.

3.2 SUBROUTINES INTERNALLY REFERENCED

3.2.1 Feed Card (XBFCD)

XBFCD is entered from the Executive, interrupt, or the execute subroutine when a feed card instruction can be issued. This section must not be entered directly from the worker program. A feed card instruction will be issued if there is no error condition in the reader, punch, or printer, and if its MAY I switch is on. This routine will immediately exit if operating under an error condition. It also turns on the 2 bit (operating bit) of the unit status list if a feed card instruction is executed.

3.2.2 Interrupt (XBITR)

XBITR is automatically entered at each cycle point 18 or when a feed card instruction is issued while an error condition exists. In case of an error interrupt, the error subroutine is entered setting the 1 bit (error) of the unit status list. (Control is returned to the worker program without stopping the computer after an appropriate treatment for the error situation.) In case of a normal interrupt, the second bit of PHI is tested against 1 and if equal, RAC is decreased by 1. XBFCD will be entered, if possible*. Further cyclical interrupts will be inhibited if there is no card in the track and if there is no error condition. If, and only if, RAC > PHI, there is at least one reserve area available to the card reader, the 1 and 4 bits at the unit status list are reset after a successful read. The tape MAY I switch is turned on if the

*The possibility is determined by testing RAC against PHI.

punch is not operating. If there are no cards in the track during interrupt, the 2 bit (operating bit) is also turned off. Executive interrupt is executed during the routine.

3.2.3 Error (XBERR)

XBERR is entered from the interrupt subroutine when an error condition is detected. The correct number of error cards is inserted in the error card counter which is the third least significant character of the reader error stop instruction. The 1 bit (error) of the unit status list is set. Feed card (XBFCD) is set to exit. The error switch in XCTRD is set to stop when all remaining good images are exhausted.

3.3 INDICATORS AND COUNTERS

3.3.1 Phase Indicator (PHI)

PHI consists of the two least significant bits of a character to which the tag XBPHI is assigned. A 1 bit is inserted in the least significant bit of PHI when a feed card instruction is issued. At each cyclical interrupt, successful or not, PHI is shifted left one bit position and a 0 bit is inserted in the least significant bit if there is no reserve area released by the worker program. The number of 1 bits in PHI shows the number of cards in the track. This number, together with the number of reserve areas filled with data, not yet processed or being processed, determines the number of reserve areas unavailable to the card reader. At each successful interrupt, the second least significant bit of PHI is tested against 1 and if equal, a card image was read into memory during the previous card cycle.

3.3.2 Read Area Indicator (RAI)

RAI consists of a character to which the label XBRAI is assigned. RAI is initially set to the total number of reserve areas. Each time the feed card subroutine is entered, RAI is decreased by 1. A feed card instruction without memory advance is issued. In the latter case, RAI is reset to the initial value.

3.3.3 Workable Area Indicator (WAI)

WAI consists of a character to which the label XBWAI is assigned. WAI is initially set to 1. Prior to giving the base address of the next reserve area ready for processing to the worker program, WAI is decreased by 1 and tested against 0. If equal, the base address is reset to the initial value and WAI is set to the total number of reserve areas. Otherwise, the base address is advanced by 128 or 192.

3.3.4 Readable Area Counter (RAC)

RAC consists of a character to which the label XBRAC is assigned. RAC is initially set to the total number of reserve areas minus 1. RAC is increased by 1 each time the execute subroutine is entered and is decreased by 1 each time a card image is successfully read into memory. Prior to giving the base address to the worker program, a test is made to determine if RAC is equal to the total number of reserve areas. If equal, the execute subroutine will wait until a card image is read into memory. Otherwise the next working area is available to the worker program.

4.0 COLUMN READER ROUTINE

In the column read routine communication with the worker program is exactly the same as it is with the row reader.

All the information stated concerning the row reader, its subroutines and construction apply directly to the column reader with the following exception:

The Phase Indicator (PHI) is nonexistent in the column reader routine. Only one card at a time may be in the track. Therefore, the error stop will indicate reload 0 or 1 cards as compared to 1 or 2 cards for the row reader routine.

There is no cyclical interrupt with the column reader routine. Card feeds are issued during interrupt approximately 0.5 milliseconds after the interrupt is received.

The routines will recover from all errors with the exception of an output jam.

REASON FOR STOP	RESULTING CONDITION	RECOVERY PROCEDURE
Stacker full Hopper empty Registration Marginal check	Recoverable	Clear problem at reader, reload number of cards as indicated by stop display even if this does not agree with the number in the error stacker. Reload hopper, and depress the READY, START, OPERATOR REQUEST, and START buttons (in that order).
All others	Nonrecoverable	Any error that causes the reader drive motor to be stopped is nonrecoverable.

Table 3. RECOVERY PROCEDURES FOR ROW AND COLUMN READER ROUTINES *REA, RDR, *REA9, RDR9, *RES, RDS, *RES9, RDS9

5.0 PUNCH ROUTINE

5.1 SUBROUTINES REFERENCED BY THE WORKER PROGRAM

5.1.1 Initialize (XINPH)

XINPH must be entered before there is any attempt to edit data for punching. All the reserve areas are cleared to spaces. Those areas between two punch areas are not altered. The channel interrupt entry is set to its appropriate value. All the indicators, counters and variable connectors are reset to their initial conditions. The base address of the first working area is given to index register two. Issue and link addresses are stored in the Executive.

5.1.2 Execute (XCTPH)

XCTPH must be entered when the worker program has finished editing data and wants it to be punched. PAC is increased by 1. A punch instruction will be issued if the previous one has been completed. The base address of the next reserve area available to the worker program is given to index register specified by p3. If none exists the 8 and 4 bits of the unit status list are set and control is transferred to the Executive. When an area becomes available, control is returned to the worker program through the link entry XC22.

5.1.3 Close Out (XCLPH)

XCLPH must be entered when the worker program wants all the remaining images to be punched and the punch unit to be cleared of data cards. After all the data cards are punched, a feed instruction is issued to send the last valid card into the output stacker.

5.2 SUBROUTINES INTERNALLY REFERENCED

5.2.1 Error (XCERR)

XCERR is entered from the interrupt subroutine when an error condition is detected. The computer is brought to an orderly stop with the following in the instruction register:

30 120000 60

When recovery is attempted through the Executive, follow-up punching will be done for the two last cards. One or two cards will be selected into the error stacker. The 1 bit (error) is set in the unit status list. The recovery switch is set in XCPCH. The Executive stop routine is executed and after the stop display, when the RUN button is depressed, control is transferred to the Executive.

5.2.2 Punch (XCPCH)

XCPCH is entered from the Executive, interrupt, or the execute subroutine when a punch instruction can be issued. The punch instruction is always issued without storage advance. The base address (tetrad 40) is updated (advanced or reset) prior to issuing the punch instruction. This section must not be entered directly from the worker program. Error recovery is effected through this routine. The tape MAY I switch is turned off upon the issuance of a punch order. The 2 bit (operating bit) is turned on.

5.2.3 Interrupt (XCITR)

XCITR is automatically entered when a punch instruction is completed successfully or not. In case of a successful interrupt, the contents of tetrad 40 are stored in a temporary storage so that it can be used for a follow-up punch when an error condition is caused by the next punch instruction. PAC is decreased by 1 and tested against 0. If PAC is not 0, XCPCH will be entered. In case of an error interrupt, the error subroutine is entered and the computer is brought to an orderly stop. The unit status list 2 and 4 bits of the punch are turned off upon successful interrupt. If the reader is not operating the tape MAY I switch is turned on. The Executive interrupt entry is executed to enable other I/O units a chance to operate.

5.3 INDICATORS AND COUNTERS

5.3.1 Punch Area Indicator (PAI)

PAI consists of a character to which the label XCPAI is assigned. PAI is initially set to 1. Each time the punch subroutine is entered PAI is decreased by 1 and tested against 0. If equal, the base address of the reserve area next to be punched (tetrad 40) is reset to the initial value and PAI is set to the total number of reserve areas. Otherwise, the base address is advanced by 128 or 192.

5.3.2 Workable Area Indicator (WAI)

WAI consists of a character to which the label XCWAI is assigned. WAI is initially set to the total number of reserve areas. Prior to giving the base address of the next reserve area ready for processing to the worker program, WAI is decreased by 1 and tested against 0. If equal, the base address and WAI are reset to their initial values.

5.3.3 Punchable Area Counter (PAC)

PAC consists of a character to which the label XCPAC is assigned. PAC is initially set to 0. PAC is increased by 1 each time the execute subroutine is entered and decreased by 1 each time a card image is successfully punched (but not yet check read). Prior to giving the base address to the worker program, a test is made to determine if PAC is larger than the total number of reserve areas minus 2. If larger, the execute subroutine will wait until a punch instruction is completed and a reserve area is released to the worker program. Otherwise, the next working area is available to the worker program.

REASON FOR STOP	INTERNAL INDICATOR	PUNCH PANEL LIGHT	RESULTING CONDITION	RECOVERY PROCEDURE	No. of cards that should be in error stacker at stop
Read check	Hole count error	Read check	Recoverable	Depress the READY, START, OPERATOR REQUEST, and START buttons (in that order).	
Stacker full	Nonready	Stacker full	Recoverable	After emptying stacker depress the READY, START, OPERATOR REQUEST, and START buttons (in that order).	0
Hopper empty	Nonready	Hopper empty	Recoverable	Load hopper with cards, depress the READY, START, OPERATOR REQUEST, and START buttons (in that order).	0
Offline	Nonready	Offline	Recoverable	Depress the OFFLINE button, the READY, START, OPERATOR REQUEST, and START buttons (in that order).	0 - initially 1 - if it occurs while punching
All others	Nonready	SKEW A & B ENTRY A & B EXIT A & B JAM POWER LOSS	*Non-recoverable (See Below)	———	1 or 0

*It is possible to recover from these errors at the risk of duplicating or losing a maximum of 2 images depending upon conditions. However, the recovery attempt will be successful in most cases. (No images lost or duplicated) for jam type errors (i.e., SKEW, ENTRY, EXIT and JAM panel lights). The punch track must be cleared and blank cards manually fed through all stations. After this is done depress the READY and START buttons. A read check will occur and the procedure for recovering from read-checks should then be followed. For other than jam type errors follow read-check procedure.

Table 4. RECOVERY PROCEDURES FOR PUNCH ROUTINES PCH, PCH9, PCHS9, *PUN, *PUN9, *PUNS9

6.0 PRINTER ROUTINE

6.1 SUBROUTINES REFERENCED BY WORKER PROGRAM

6.1.1 Initialize (XINPR or XINP7)

XINPR must be entered before there is any attempt to edit data to be printed. All the reserve areas are cleared to spaces. The channel interrupt entry is set to its appropriate value. All the indicators, counters, and variable connectors are reset to their initial conditions. The base address of the first working area is given to index register three. The link and issue addresses are stored in the Executive.

6.1.2 Execute (XCTPR or XCTP7)

XCTPR must be entered when the worker program has finished the editing of data and wants it to be printed. XADVC must be supplied with the number of lines to be advanced by the worker program before entering XCTPR. XADVC is transferred to one of the temporary storages. PAC is increased by 1. A print instruction will be issued if the previous one has been completed. The base address of the next reserve area available to the worker program is given in the index register specified by p3, if one exists, otherwise the 4 and 8 bits of the unit status list are set and control is transferred to the Executive link. When an image area becomes available control will be transferred to the worker program from the Executive through the printer link entry XA22.

6.1.3 Close Out (XCLPR or XCLP7)

XCLPR must be entered when the worker program wants all the remaining images to be printed. This section is entered each time the remote print or the advance paper subroutine is entered.

6.2 SUBROUTINES INTERNALLY REFERENCED

6.2.1 Print (XAPRT or XAPR7)

XAPRT is entered from the Executive, interrupt, or the execute subroutine when a print instruction can be issued. The print instruction is always issued without memory advance. Prior to issuing the print instruction the base address (tetrad 32) is updated (advanced or reset) and the line advance count (tetrad 33) is supplied with the appropriate number of lines to be advanced, if the MAY I switch is off no print instruction is issued. Error recovery is effected through this routine. This section must not be entered directly from the worker program. The 2 bit (operating bit) is turned on when the XF is issued.

6.2.2 Interrupt (XAITR)

XAITR is automatically entered when a print instruction is completed successfully or not. In case of a successful interrupt, PAC is decreased by 1 and tested against 0. If PAC is not 0, XAPRT will be entered. In case of an error interrupt, the error subroutine is entered and the computer is brought to an orderly stop. The Executive interrupt routine is executed during this time to enable other peripherals to operate. The 2 and 4 bits of the unit status list are reset upon successful interrupt.

6.2.3 Advance Paper (XCTAD or XCTA7)

XCTAD must be entered when the worker program wants the paper to be

advanced the number of lines specified. This number must be supplied to XADVC before entering XCTAD. XCLPR is executed before issuing the advance paper instruction.

6.2.4 Call (XCTOL) or (XCT07)

XCTOL must be entered when the worker program wants a 'remote area' to be printed. A 'remote area' is a print area which is not included in the reserve areas. The worker program can place any number of remote areas anywhere it wants as far as the storage capacity permits. XCTOL can be used to print such things as heading lines, page numbers, and so on from these remote areas saving the worker program the trouble of transferring constants to reserve areas. Prior to entering XCTOL, the worker program must supply the location XRMAR (3 characters) with the base address of the remote area and XADVC with the number of lines to be advanced. The size of a remote area must be the same as for a reserve area, that is, 128 characters in the full line mode or 64 characters in the half line mode. XCLPR is executed before issuing the print instruction.

6.2.5 Error (XAERR)

XAERR is entered from the interrupt subroutine when an error condition is detected. The unit status list 1 bit is set. The computer is brought to an orderly stop with the following in the instruction register, after the XCORD stop routine is executed:

30 100000 60

When recovery is attempted through the Executive, the previous print or paper advance instruction will be reissued. Then control is returned to the worker program.

NOTE: Communication between the worker program and the print routine is effected as previously noted through JRs to various labels. In the case of the channel 7 print routine, the labels involved in the JRs have the least significant digit changed to seven (7).

6.3 INDICATORS AND COUNTERS

6.3.1 Print Area Indicator (PAI)

PAI consists of a character to which the label XAPAI is assigned. PAI is initially set to 1. Each time the print subroutine is entered, PAI is decreased by 1 and tested against 0. If equal, the base address of the next reserve area to be printed (tetrad 32) is reset to the initial value and PAI is set to the total number of reserve areas. Otherwise the base address is advanced by 64 or 128.

6.3.2 Workable Area Indicator (WAI)

WAI consists of a character to which the label XAWAI is assigned. WAI is initially set to the total number of reserve areas. Prior to giving the base address of the next reserve area ready for processing to the worker program, WAI is decreased by 1 and tested against 0. If equal, the base address and WAI are reset to their initial values.

6.3.3 Printable Area Counter (PAC)

PAC consists of a character to which the label XAPAC is assigned. PAC is initially set to 0. PAC is increased by 1 each time the execute subroutine is entered and decreased by 1 each time a line is successfully printed. Prior to giving the base address to the worker program, a test is made to determine if PAC is equal to the total number of reserve areas. If equal, the execute subroutine will wait until a print instruction is completed and a reserve area is released to the worker program. Otherwise the next working area is available to the worker program.

6.3.4 Storage Indicators (XADVC)

There are two 3 character indicators which control the transfer of

the number of lines to be advanced (XADVC) to temporary storages and to tetrad 33. One of them appears in the execute subroutine and is used to store (XADVC) to one of the temporary storages. The other appears in the print subroutine and is used to bring the contents of the proper temporary storage into tetrad 33.

6.4 PAPER LOW MANUAL PRINT OPTION FOR ROUTINES PRNT, PRNT7, PRPL, PRPL7, *PRT, *PRPL

A. This option allows the worker program at the additional cost of 80 characters to print to the end of a page (i.e., fixed forms, etc.) when the printer stops in a paper low condition.

The stops are different from normal error stops and are as follows:

Channel 0 Printer (PRNT) 30 010700 60
Channel 7 Printer (PRNT7) 30 017700 60

To include this option in the print routine change the PROC call line as follows:

Use PRPL in place of PRNT
Use PRPL7 in place of PRNT7

B. The following procedure must be used when the paper low stop is reached:

Depress the MANUAL PRINT button, then the START button. This will cause one line to be printed and the program will return to the paper low stop. Continue this procedure until the last line for that page is printed or until page advance is executed (paper now past hammers). At this point reload paper stock, depress the MANUAL PRINT and START buttons, and the program will continue.

REASON FOR STOP	INTERNAL INDICATOR	PRINTER PANEL LIGHT	RESULTING CONDITION	RECOVERY PROCEDURE
Offline	Nonready	Offline	Recoverable	Depress the OFFLINE, READY, START, OPERATOR REQUEST, and START buttons (in that order).
Carriage out	Nonready	Carriage out	Recoverable	Depress CARRIAGE IN until carriage is completely in, then READY, START, OPERATOR REQUEST, and START buttons (in that order).
Ribbon out	Nonready	Ribbon out	Recoverable	Call technician. When ribbon restored depress the READY, START, OPERATOR REQUEST, and START buttons (in that order).
Paper low - if paper low option has been called in the print PROC	Paper low	Forms out	Recoverable	Depress MANUAL PRINT button and START. This will cause one line to be printed. Continue this procedure until all printing is finished for that page or until line advance between pages is executed, then reload new paper stock. Depress MANUAL PRINT and START, and the program will continue.
All others	Nonready	Overheat D.C. fault forms runaway etc.	Nonrecoverable	If recovery attempt is desired at risk of a lost or duplicated line, clear problem, depress READY, START, OPERATOR REQUEST, and START buttons (in that order).

NOTE: The recovery procedure for the tape system using the Executive is exactly the same as stated above with one exception. After START button is depressed the OPERATOR REQUEST button must be depressed to signal the Executive that an error recovery attempt is being made. Depressing the START button after this will cause the program to attempt recovery.

Table 5. RECOVERY PROCEDURES FOR PRINTER ROUTINES PRNT, PRNT7, PRPL, PRPL7, *PRT, *PRPL